

EXECUTIVE SUMMARY

RE: CONTRACT NO. DACA31-87C-0012  
EEAP - BOILER/CHILLER STUDY  
FT. DIX, NEW JERSEY

19971021 335

1987

1. INTRODUCTION

In accordance with contract No. DACA31-87C-0012, Furst Energy, Inc. is pleased to submit this Pre-Final Submittal report.

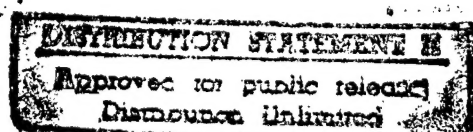
This report covering the twenty-two boilers and three chillers at Ft. Dix, New Jersey, has identified well over \$1,600,000.00 of potential energy savings. All of the savings recommendations have been cordially reviewed by Ft. Dix personnel and several have already been agreed upon for implementation.

There are a number of recommendations identified that have extremely advantageous returns. Specifically, with an investment of only \$8,625, over \$565,000.00 worth of energy savings could begin to accrue immediately (please see ECO's #4,5,6,7,19,20,45,46, and 47). Furst Energy strongly recommends that whatever is necessary to secure funding for these projects should be done immediately.

Section 2 of this submittal includes the performance data for the boilers and chillers which were tested, and for which efficiency results were calculated. There are a total of twenty-two boilers installed at this facility, and of this number five could not be tested. There are a total of three chillers installed at this facility, and of this number, one could not be tested.

Section 3 - Energy Conservation Opportunities (ECO) are detailed which show the energy savings (MBTU), first year savings (\$), investment (\$), savings investment ratio (SIR), and payback (years). A listing of all the ECO's in descending SIR order is attached to this executive summary as Schedule A.

Schedule B is an ECO listing by groups of similar opportunities and classified by programming documentation.



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DEPARTMENT OF THE ARMY  
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS  
P.O. BOX 9005  
CHAMPAIGN, ILLINOIS 61826-9005

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## 2. BUILDING DATA

The buildings referenced in this report are boiler houses which generated steam for distribution to other buildings, boiler houses which generate hot water for distribution to other buildings and chiller plants which generated chilled water for distribution to other buildings. The contract restricted the work of Furst Energy, Inc. to the boiler plants, chiller plants, and supporting systems. However, the steam, hot water, and chilled water distribution systems were not studied and not included in this report as per the Scope of Work. The various buildings and their functions are as follows:

<u>BUILDING</u>	<u>FUNCTION</u>
5426	Steam Generation
5881	Steam Generation
5324	Steam Generation
5252	Steam Generation
3379	Hot Water Generation
3420	Hot Water Generation
3442	Hot Water Generation
0971	Hot Water Generation
5251	Chilled Water Generation
5656	Chilled Water Generation

## 3. PRESENT ENERGY CONSUMPTION

### A. Total Annual Energy Used

		F U E L      O I L		
<u>BUILDING</u>	<u>FUEL</u>	<u>GALLONS</u>	<u>COST (\$)</u>	<u>MBTU</u>
5426	#6 OIL	3,629,600	2,734,100	541,400
5881	#6 OIL	3,014,200	2,269,700	449,500
5324	#4 OIL	330,600	248,900	49,300
0971	#4 OIL	349,400	263,100	52,100
3379	#4 OIL	270,800	203,900	40,400
3420	#4 OIL	92,400	69,600	13,800
3442	#4 OIL	<u>99,700</u>	<u>75,100</u>	<u>14,800</u>
TOTAL		7,786,700	5,864,400	1,161,300

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## E L E C T R I C I T Y

<u>BUILDING</u>	<u>KWH</u>	<u>COST (\$)</u>	<u>MBTU</u>
5426	1,159,400	91,300	3,960
5881	1,101,400	86,700	3,760
5324	579,700	45,600	1,980
0971	376,900	26,400	1,150
3379	149,200	10,400	450
3420	49,600	3,480	150
3442	39,500	2,760	130
5251	959,400	67,200	2,900
5656	<u>145,400</u>	<u>10,200</u>	<u>440</u>
 TOTAL	 4,560,500	 344,040	 14,920

NOTE: These figures represent only the energies used in the buildings listed above.

4. HISTORICAL ENERGY CONSUMPTION

A comparison with the basewide energy consumption cannot be made, since this study did not include any buildings other than those listed.

<u>BUILDING</u>	<u>GRADE OIL</u>	<u>FY1985</u>	<u>FY1986</u>	<u>FY1987</u>
5426	#6	2,291,645	3,569,025	3,715,136
5881	#6	2,950,619	2,784,991	2,422,803
5324	#4	330,596	333,176	*
0971	#4	342,825	*	*
3379	#4	295,891	*	*
3442	#4	125,998	*	*
3420	#4	115,527	*	*

This represents all the available fuel oil data. Annual electricity costs were not available for the years listed above and, therefore, could not be included in this report.

\* These figures were not received from Ft. Dix personnel in time for report preparation. These figures will be included in the Final Submittal.

## EXECUTIVE SUMMARY

### 5. ENERGY CONSERVATION ANALYSIS

#### A. ECO'S INVESTIGATED

The "Boiler Field Survey Data" sheets in Section 8 of the report comprise 27 different energy savings opportunities. Each of these have been addressed for each building, and appropriate comments have been included.

#### B. ECO'S DEVELOPED

Section 5 contains all the ECO's that have been developed, including the energy savings (MBTU), cost savings (\$), investment (\$), SIR, and payback (years). There are a total gross savings of \$1,607,016.00 and an investment of \$1,549,880. The ECO's are grouped according to: Value Engineering, QRIP, or PECIP. The SIR has been developed for each ECO, and the payback has been developed for each group. Individual ECO's in accordance with Schedule A of this executive summary are contained in Sections 3 and 4 of this submittal.

#### C. ECO'S REJECTED

The "Boiler Field Survey Data" sheets appearing in Section 8 of the submittal indicate those ECO's which have been investigated and rejected with pertinent explanations. These data sheets apply to each building that was studied, and are sufficiently detailed to explain the action taken.

#### D. OPERATIONAL OR POLICY CHANGE RECOMMENDATIONS

##### 1. Fuel Oil Purchase

The predominant boiler fuels used at this base are #4 and #6 oils, both are of the residual classification. Fuel oil analyses that were made indicate that the #6 fuel oil has a greater potential for improvement than does #4 oil. For this reason it is recommended that better control in purchasing #6 oil be implemented. This subject is addressed in detail in ECO#5-5426-1,2,3,4 and ECO#6-5881-1,2,3,4.

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### 2. Fuel Oil Testing

It is proposed that the fuel oil supplies at Ft. Dix be sampled and analyzed. Fuel oil is used for boiler operations at the following buildings: 5324, 5426, 5252, 5881, 0971, 3379, 3420, and 3442. The fuel oil analyses are of two types: A - Regular Analysis

B - Spectrographic Analysis

#### A - Regular Analysis

Gravity, API	Heating Value, BTU/gal
Flash Point, °F	BS&W, volume %
Viscosity, SSU @ 100°F.	Sodium, PPM
Sulfur, wt. %	Vanadium, PPM
Pour Point, max. °F.	

#### B - Spectrographic Analysis

copper, lead, tin, aluminum, nickel, chromium, iron, sodium, boron, silicon, magnesium, calcium, phosphorous, zinc, titanium, antimony, molybdenum, barium, and cadmium.

The recommended frequency of the fuel oil sampling for the regular and spectrographic analyses would be once per month for the first 3 months, then every 2 months for the next six months. The fuel oil samples shall be from the fuel oil being supplied to the boilers.

From a sample of the fireside boiler tube deposits, a spectrographic analysis should be made to determine the following ingredients.

copper, lead, tin, aluminum, nickel, chromium, iron, sodium, boron, silicon, magnesium, calcium, phosphorous, zinc, titanium, antimony, molybdenum, barium, cadmium, and sulfur.

The fireside deposits analysis should be made on an annual basis and include the following boilers:

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<u>BUILDING</u>	<u>NO. OF BOILERS</u>
5324	2
5426	4
5252	3
5881	4
0971	3
3379	2
3420	2
3442	2
	<hr/>
TOTAL	22

## 3. Boiler Operating Training

An instructional program should be implemented to improve the knowledge and skills of boiler operators. As new operators are employed, they should be provided with a training program to improve their operating skills. The training program should contain subject matter which would enable operators to pass a state licensing test. Basic boiler theory as well as practical operating procedures should be included in a comprehensive training program.

## 4. Boiler Log Sheets

The current log sheets do not contain sufficient information to determine the boiler operating efficiency. Revisions to the log sheets are necessary to fully evaluate a boiler's performance. The operators could then make corrections immediately to restore the boiler to optimum conditions. Combustion efficiencies should be determined using a Bacharach Fyriser portable analyzer or an equivalent instrument. The overall boiler efficiency should be computed using steam flow meters, enthalpy, pressure, fuel heating value, ambient air temperatures and feedwater temperature.

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### 5. Activate Boiler House 5252

Boiler houses 5252 and 5426 operate in parallel with each other and supply steam to the hospital and other buildings. Boiler house 5252 has three 40,000 PPH boilers which are in much better physical condition than the boilers in building 5426. This is due to the fact that they have been maintained in idle standby. Most of the existing equipment is in good condition, however, some work would be required to fully activate boiler house 5252. Specifically, water softeners should be installed and the boiler instruments should be repaired and calibrated. Results of boiler efficiency tests show that boiler house 5252 is more efficient than boiler house 5426. For example, the combustion efficiencies at 5252 averaged 76.5%, while 5426 boilers averaged 69.9%, for a difference of 6.6%. Utilization of boiler house 5252 should be given strong consideration in lieu of boiler house 5426.

### 6. Cogeneration

Future studies should be made to explore the potential application of cogeneration systems to Ft. Dix. This can take different forms, such as:

a. Combination electricity and hot water generation. The electricity generated could be tied into the electrical grid for distribution throughout Ft. Dix. Hot water could be generated from either natural gas fired or diesel fired engines driving a generator. Ft. Dix hot water requirements are large enough on a year round basis to justify this type of system.

b. Steam turbine driven generators could be applied to develop electricity for distribution in the grid. The average boiler steam pressure at 120 psig is near the minimum advisable for operating steam turbines, but would still be a practical application.

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### 7. New High Pressure Steam Boilers

New high pressure steam boilers should be considered for any future installations. Boilers with a steam pressure of approximately 600 psig could be a fine steam source for driving turbines coupled with generators. The turbines would exhaust at 120 psig and this steam could be connected to the existing distribution network. This would also provide a good source of steam for the cogeneration system discussed in the previous paragraph.

### 8. Sub-Meter Installation

The measurement of electricity at the various boiler houses is not possible since there are not any meters. The installation of sub meters at each boiler house would provide the means to determine the electricity demand and usage. This information would be useful in managing electrical usage and costs, and would allow future savings to be developed.

### 9. Data Management System

A system to track the energy efficiency of the major users at Ft. Dix should be instituted. This function should be assigned to some existing department on post and be supported by the base commander. The purpose of such a system would be to track and document savings from energy conservation measures, and to insure that realized savings are not lost in the future to lack of vigilance.

This system will require the addition of new log sheets in some facilities and the modification of others. It will also require the addition of meters to measure the usage of energy. Much of this may be able to be collected by the Facilities Management System presently being installed. Also the daily tracking and recording of weather data should be done.

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Computerized programs for the storage and analysis of this data should be purchased or developed. Any software considered should be capable of analysis, storage and tracking by the use of BIN type weather data. The main function of this system will be to establish an energy consumption data base for Ft. Dix and to compare future energy usages to past usage. These comparisons should be on a boiler plant by boiler plant basis with weather and population data factored into the analysis. Within the larger plants it should be able to compare combustion efficiencies between individual machines and thereby determine what corrective action should be taken.

### 10. General Comments

Furst Energy enjoyed the cooperation and enthusiasm of all the participants involved in performing this contract. However, it is our belief that some revisions in working procedure would make for a smoother and more efficient contract performance, especially for contractors performing DOD work for the first time. Specifically, it would be more helpful to have increased input into exact report preparation content and style, including pertinent examples of past successful submittals. Also, an index and brief description of pertinent government forms with instructions for their proper completion would facilitate report preparation. Finally, complete background data on equipment, energy costs, energy usages, and operation would be most helpful in avoiding time consuming delays.

## SCHEDULE A

<u>ORIGINAL ECO #</u>	<u>PAGE NO.</u>	<u>\$ INVEST</u>	<u>\$ SAVINGS</u>	<u>SIR</u>	<u>PAYBACK</u>
47-5426-1,2,3	3.1	10	133,280	11,987	0.0000
45-5881-1,2,3,4	3.6	10	38,345	3,449	0.0003
46-5324-1,2,	3.11	10	17,190	1,546	I
4-5426-1,2,3	3.16	950	152,882	1,295	0.006
5-5426-1,2,3,4	3.19	900	54,676	988	0.016
6-5881,1,2,3,4	3.26	900	46,480	840	0.19
7-5881-1,2,3,4	3.33	950	51,377	443	0.18
41-0971-1,2,3	3.36	19,211	15,593	109	1.23
10-5324-1,2	3.39	950	5,669	53	0.168
11-5426-1,2,3	3.42	49,990	146,714	46	0.34
15-5881-1,2,3	3.50	49,990	103,203	33	0.48
9-5426-1,2,3	3.57	15,471	19,216	21	0.81
12-5426-1,2,3	3.63	5,192	5,935	19	0.875
14-5426-1,2,3	3.67	76,854	88,244	19	0.87
1-5426-1,2,3	3.75	172,080	204,834	19	0.84
8-5881-1,2,3,4	3.81	18,239	16,965	16	1.08
18-5324-1,2	3.87	12,605	12,582	16	1.00
19-5426-1,2,3	3.93	2,564	38,311	14	0.067
17-5881-1,2,3,4	3.96	81,202	67,360	14	1.2
20-5881-1,2,3,4	3.105	2,331	33,445	13	0.069
23-0971-1,2,3	3.107	600	761	9	0.79
24-5324-1,2	3.110	28,989	12,672	7	2.29
27-0971-1,2,3	3.113	6,743	4,100	7	1.64
25-3379-1,2	3.115	3,196	1,722	6	1.85
16-3420-1,2	3.117	10,035	5,362	6	1.87
26-5426-1,2,3	3.120	8,517	54,681	6	0.16
2-5881-1,2,3,4	3.136	261,054	77,649	5	3.4
28-5426-1,2,3	3.142	5,229	2,043	5	2.56
29-3420-1,2	3.147	2,158	743	4	2.9
30-3442-1,2	3.149	2,448	784	4	3.1
13-0971-1,2,3	3.151	9,990	3,266	4	3.06
3-5251-1,2	3.154	238,343	64,718	3	3.68
31-5881-1,2,3	3.157	7,877	2,075	3	3.8
32-3379-1,2	3.162	52,643	19,801	3	2.66
21-5324-1,2	3.165	53,340	8,228	3	6.48
35-0971-1,2,3	3.174	55,235	14,276	2	3.87
37-5251-1,2	3.177	41,105	7,076	2	5.81
38-5656-1,2	3.179	105,524	9,621	2	10.97
39-5324-1,2	3.182	1,719	3,013	2	0.57
40-5881-1,2,3,4	3.184	10,131	46,480	1	0.22
22-3379-1,2	3.200	21,148	4,203	1	5.03
42-3420-1,2	3.206	51,658	4,507	1	11.46
43-5324-1,2	3.209	10,131	4,823	1	2.1
44-3442-1,2	3.224	51,658	2,111	1	24.5
TOTAL		\$1,549,880	\$1,607,016		

## SCHEDULE B

## ECO PROJECT GROUPINGS

<u>ECO NO.</u>	<u>TITLE DESCRIPTION</u>	<u>\$ INVEST.</u>	<u>\$ SAVINGS</u>	<u>SIR</u>	<u>GROUP PYBCK*</u>	<u>PROJECT GROUP</u>
(VALUE ENGINEERING PROJECTS)						
45-5881-1,2,3,4	Adjust	10	38,345	3,449	IMM.	VL-ENG
46-5324-1,2	Fuel Oil	10	17,190	1,546		
47-5426-1,2,3	Temperature	10	133,280	11,987		
		30	188,815			
22-3379-1,2	Summer Boiler	21,148	4,203	1.37	5	VL-ENG
23-0971-1,2,3	Motion Sensor	600	761	9	.79	VL-ENG
38-5656-1,2	Chiller Replacmnt	105,524	9,621	2.	10.9	VL-ENG
42-3420-1,2	Combustion	51,658	4,507	1	15.6	VL-ENG
44-3442-1,2	Efficiency	51,658	2,111	.4		
		103,316	6,618			

## SCHEDULE B

<u>ECO NO.</u>	<u>TITLE DESCRIPTION</u>	<u>\$ INVEST.</u>	<u>\$ SAVINGS</u>	<u>SIR</u>	<u>GROUP PAYBACK*</u>	<u>PROJECT GROUP</u>
(PECIP PROJECTS)						
5-5426-1,2,3,4	F.O. Spec.	900	54,676			
6-5881-1,2,3,4	" "	900	46,480		0.018	PECIP
		<u>1,800</u>	<u>101,156</u>			
14-5426-1,2,3	Economizers	76,854	88,244	19		
17-5881-1,2,3	"	81,202	67,360	14	1.48	PECIP
21-5324-1,2	"	53,340	8,228	3		
37-5251-1,2	"	41,105	7,076	2		
		<u>252,501</u>	<u>170,908</u>			
24-5324-1,2	Dual Fuel	28,989	12,672	7		
2-5881-1,2,3,4	" "	261,054	77,649	4.9	1.6	PECIP
1-5426-1,2,3,4	" "	172,080	204,834	19		
		<u>462,123</u>	<u>295,155</u>			
16-3420-1,2	Reset Controls	10,035	5,732	6		
13-0971-1,2,3	" "	9,990	3,636	4	2.1	PECIP
		<u>20,025</u>	<u>9,368</u>			
27-0971-1,2,3	High Eff. Motors	6,743	4,100	7		
25-3379-1,2	" "	3,196	1,722	6	2.3	PECIP
28-5426-1,2,3	" "	5,229	2,043	5		
31-5881-1,2,3	" "	7,877	2,075	3		
		<u>23,045</u>	<u>9,940</u>			
29-3420-1,2	Pump Reductions	2,158	743	4		
30-3442-1,2	" "	2,448	784	4	3.	PECIP
		<u>4,606</u>	<u>1,527</u>			
32-3379-1,2	Oxygen Trim	52,643	19,801	3		
35-0971-1,2,3	" "	55,235	14,276	2	3.17	PECIP
		<u>107,878</u>	<u>34,077</u>			
3-5251-1,2	Chiller Retrofit	238,343	64,718	3.	3.7	PECIP

\* PAYBACK IN YEARS

## SCHEDULE B

<u>ECO NO.</u>	<u>TITLE DESCRIPTION</u>	<u>\$ INVEST.</u>	<u>\$ SAVINGS</u>	<u>SIR</u>	<u>GROUP PYBCK*</u>	<u>PROJECT GROUP</u>
(QRIP PROJECTS)						
4-5426-1,2,3	Combustion	950	152,882	1,295		
7-5881-1,2,3,4	Monitoring	950	51,377	443	.014	QRIP
10-5324-1,2	"	950	5,669	53		
		<u>2,850</u>	<u>209,928</u>			
11-5426-1,2,3	Variable	49,990	146,714	46		
15-5881-1,2,3	Speed Drives	49,990	103,203	33	.40	QRIP
		<u>99,980</u>	<u>249,917</u>			
43-5324-1,2	Instrument	10,131	4,823	0.4		
26-5426-1,2,3	Service	8,517	54,681	6.	0.3	QRIP
40-5881-1,2,3,4	"	10,131	46,480	1.		
		<u>28,779</u>	<u>105,984</u>			
19-5426-1,2,3	Clean Firesides	2,564	38,311	14		
20-5881-1,2,3,4	" "	2,331	33,445	13	.088	QRIP
39-5324-1,2	" "	1,719	3,013	2		
		<u>6,614</u>	<u>74,769</u>			
12-5426-1,2,3	Boiler Ins.	5,192	5,935	19	.87	QRIP
9-5426-1,2,3	Blowdown/HC	15,471	19,216	21		
8-5881-1,2,3,4	"	18,239	16,965	16	.95	QRIP
18-5324-1,2	"	12,605	12,582	16		
		<u>46,315</u>	<u>48,763</u>			
41-0971-1,2,3	Imp.Controls	19,211	15,593	109	1.2	QRIP
(NON-QUALIFYING PROJECTS)						
34-0971-1,2,3	" "	21,903	- 10,238	- 10.92	THESE PROJECTS DO NOT QUALIFY	
36-3442-1,2	" "	12,871	- 3,750	- 7.2		
33-3420-1,2	" "	12,871	- 2,883	- 5.6		

\* PAYBACK IN YEARS